

CLAIMS

1. An article with an organic-inorganic composite film, the article comprising a substrate and an organic-inorganic composite film that is 5 formed on a surface of the substrate and contains an organic material and an inorganic oxide,
 - wherein the organic-inorganic composite film contains silica as the inorganic oxide,
 - the organic-inorganic composite film contains the silica as its main 10 component, and
 - the organic-inorganic composite film does not separate from the substrate after the Taber abrasion test prescribed in Japanese Industrial Standards R 3212 that is carried out with respect to a surface of the organic-inorganic composite film.
- 15 2. The article according to claim 1, wherein the organic-inorganic composite film has a thickness of more than 250 nm but not more than 5 μm .
3. The article according to claim 2, wherein the organic-inorganic 20 composite film has a thickness of more than 300 nm but not more than 5 μm .
4. The article according to claim 3, wherein the organic-inorganic composite film has a thickness of 1 μm to 5 μm .
- 25 5. The article according to claim 1, wherein a portion that has been subjected to the Taber abrasion test has a haze ratio of 4% or lower after the Taber abrasion test.
6. The article according to claim 1, wherein the content of the organic 30 material in the organic-inorganic composite film is 0.1 to 60% with respect to the total mass of the organic-inorganic composite film.
7. The article according to claim 1, wherein the organic-inorganic composite film contains phosphorus.
- 35 8. The article according to claim 1, wherein the organic-inorganic composite film contains a hydrophilic organic polymer as the organic

material.

9. The article according to claim 8, wherein the hydrophilic organic polymer includes a polyoxyalkylene group.

5

10. The article according to claim 1, wherein the organic-inorganic composite film contains fine particles.

11. The article according to claim 10, wherein the content of the fine particles is at least 1 mass%, and a portion that has been subjected to the Taber abrasion test has a haze ratio of 4% or lower after the Taber abrasion test.

12. A process for producing an article with an organic-inorganic composite film, the article including a substrate and an organic-inorganic composite film that is formed on a surface of the substrate and contains an organic material and an inorganic oxide, the organic-inorganic composite film containing silica as the inorganic oxide, and the organic-inorganic composite film containing the silica as its main component,

20 the process comprising:

applying a film-forming solution for forming the organic-inorganic composite film to the surface of the substrate; and

removing at least a part of a fluid component contained in the film-forming solution from the film-forming solution that has been applied to 25 the substrate,

wherein the film-forming solution contains silicon alkoxide, strong acid, water, and alcohol,

the film-forming solution further contains a hydrophilic organic polymer to be at least a part of the organic material, as at least a part of the 30 strong acid or as a component other than the strong acid,

the silicon alkoxide has a concentration exceeding 3 mass% in terms of a SiO₂ concentration when silicon atoms contained in the silicon alkoxide are expressed as SiO₂,

35 a) in the case where the film-forming solution contains a phosphorus source, the strong acid has a concentration in a range of 0.0001 to 0.2 mol/kg in terms of the molality of protons that is obtained assuming that the protons have dissociated completely from the strong acid,

b) in the case where the film-forming solution contains no phosphorus source, the strong acid has a concentration in a range of 0.001 to 0.2 mol/kg in terms of the molality of protons that is obtained assuming that the protons have dissociated completely from the strong acid, and the silicon alkoxide has a concentration of lower than 13 mass% in terms of the SiO_2 concentration,
5 the number of moles of the water is at least four times the total number of moles of the silicon atoms contained in the silicon alkoxide, and
10 at least a part of the fluid component contained in the film-forming solution that has been applied to the substrate is removed, with the substrate being maintained at a temperature of 400°C or lower.

13. The process for producing an article according to claim 12, wherein the concentration of the hydrophilic organic polymer is:

15 c) 30 mass% or lower with respect to the SiO_2 , in the case where the silicon alkoxide has a concentration of 9 mass% or lower in terms of the SiO_2 concentration, and

d) $(5A - 15)$ mass% or lower where A denotes the SiO_2 concentration, in the case where the silicon alkoxide has a concentration exceeding 9 mass% in terms of the SiO_2 concentration.

20

14. The process for producing an article according to claim 12, wherein the silicon alkoxide contains at least one selected from tetraalkoxysilane and a material made by polymerization of tetraalkoxysilane.

25

15. The process for producing an article according to claim 12, wherein the silicon alkoxide has a concentration of 30 mass% or lower in terms of the SiO_2 concentration.

16. The process for producing an article according to claim 12, wherein at least a part of the phosphorus source is phosphoric acid that is contained as at least a part of the strong acid.

17. The process for producing an article according to claim 12, wherein at least a part of the phosphorus source is a phosphoester group that is contained in the hydrophilic organic polymer.

18. The process for producing an article according to claim 12, wherein

the hydrophilic organic polymer contains a polyoxyalkylene group.

19. The process for producing an article according to claim 12, wherein the number of moles of the water is 5 to 20 times the total number of moles of the silicon atoms that are contained in the silicon alkoxide.
- 5
20. The process for producing an article according to claim 12, wherein the film-forming solution further contains fine particles.
- 10 21. The process for producing an article according to claim 12, wherein the organic-inorganic composite film with a thickness of more than 250 nm but not more than 5 μm is formed by carrying out each of the following steps once: a step of applying the film-forming solution; and a step of removing at least a part of the fluid component contained in the film-forming solution that has been applied.
- 15